REMARKS

Claims 1-34 are pending in the present application. No amendment has been made in this response.

Claims 1-3, 6-7, 10-17, 20-23, 26-29, and 32-34 stand rejected under 35 USC 103(a) as being unpatentable over Huang et al. (US 6,067,292) in view of Kadous et al. (US 6,654,408)

Claims 1-3, 6-7, 10-17, 20-23, 26-29, and 32-34 stand rejected under 35 USC 103(a) as being unpatentable over Huang et al. in view of Kadous et al. The examiner alleges that the combination of Huang et al. and Kadous et al. discloses all claimed features and therefore makes the claims unpatentable for being obvious. This allegation is not supported by the cited references; applicants respectfully traverse the rejections for the following reasons.

1. The present invention

The present invention achieves the reduction of noises in a transformed signal by first reconstruction of one or more weakest subcarriers and then replacement of the reconstructed subcarriers for the

corresponding received subcarriers. See, *e.g.*, [0044]-[0049]. One principle of the present invention is based on the realization that as weak subcarriers are amplified with high gain, such weak subcarriers introduce a high level of noise; therefore replacing the weak subcarriers results in reduction of noise amplification from weak signal components. See, *e.g.*, [[0034], [0025]. In addition, no signal component is abandoned and therefore orthogonality of signal components of the transformed signal is not destroyed. See, *e.g.*, [0026]. Finally, the identification of subcarriers for reconstruction is based on channel parameters (*e.g.*, smallest channel coefficients). See, *e.g.*, [0040], [0044]. As discussed hereinbelow, the present invention differs from the cited references in both principle and implementation.

2. Claimed subject matters in Claims 1-3, 6-7, 10-17, 20-23, 26-29, and 32-34

The claimed subject matters as represented by claim 1 are directed to methods and systems for reducing noise in a transformed signal having a plurality of signal components on different subcarriers. The reduced noise transformed signal is obtained by <u>identifying</u> one or more signal components having one or more smallest channel coefficients

based upon a channel estimate of said plurality of signal components, reconstructing a predetermined number of times of the identified one or more signal components to thereby reduce noise, and replacing said identified one or more signal components for reconstruction with the reconstructed one or more signal components to provide a new transformed signal having one or more reconstructed signal components with reduced noise. As highlighted above, the reduced noise transformed signal is achieved by a sequence of operations that are not taught or suggested by the cited references, even if the cited references are impermissibly combined.

3. No *prima facie* case of obviousness for Claims 1-3, 6-7, 10-17, 20-23, 26-29, and 32-34 over Huang et al. and Kadous et al.

First, the system and method disclosed in Huang et al. are based on the technical feature that the transmitted signal is comprised of pilot and data; by reconstructing the pilot signal and cancelling (*i.e.*, subtracting) the reconstructed pilot signal from all paths the path interferences are reduced in the transformed signal. As discussed above, the claimed subject matters of claims 1-3, 6-7, 10-17, 20-23, 26 - 29 and 32-34 are directed to methods and systems that reconstruct one or

more weakest subcarriers in a transmitted signal and then replacing the correspondingly original weakest subcarriers with the reconstructed subcarriers so that the noises resulting from the high amplification gain of the weakest subcarriers are reduced or eliminated, achieving the reduction of noise in the transformed signals. It is apparent that Huang et al. fail to teach or suggest the reduction of noises in a transformed signal by reconstructing one or more weakest subcarriers. For the sake of argument heretofore, even with the teaching of Kadous et al. that enables the identification of the weakest paths in a transmitted signal, if one or more weakest paths are reconstructed with the pilot data and cancelled with the reconstructed pilot data according to the teachings of Huang et al., how then will the transformed signal be formed with some paths still having the pilot data? The examiner clearly fails to show. Therefore, applicant respectfully submits that no *prima facie* case of obviousness for claims 1-3, 6-7, 10-17, 20-23, 26 -29 and 32-34 be made over Huang et al. and Kadous et al.

Second, while applicant respectfully believe that the above argument be enough for rebutting the rejections, the following discussions of the implementation of the systems and methods disclosed

in Huang et al. are provided for better illustrating the differences between the references and the claimed subject matters of the present application.

(1) <u>*The features of the received signals in Huang et al.*</u>

The transmitted signal in the system of Huang et al is a summation of pilot and data (102 in FIG 1) as shown in equation (1) below.

$$sg(t) = pi(t) + da(t) \qquad (1)$$

The signal arriving at the receiver after passing through the channel is a composite signal which includes L multipath components (illustrated in FIG 6, 601 and 602 for 2 paths). The multipath components are differed in attenuation α, phase ϕ and path delay τ (col 7 line 58-59). Thus the received signal r(t) as (ignoring Gaussian noise for simplicity) may be written in the following equation (2).

$$\begin{aligned} r(t) &= signal\_from\_path\_0 + \ldots + signal\_from\_path\_L-1 \\ &= \alpha_0 e^{j\phi_0} sg(t-\tau_0) + \ldots + \alpha_{L-1} e^{j\phi_{L-1}} sg(t-\tau_{L-1}) \end{aligned} \qquad (2)$$

Substituting (2) with (1) gives equation (3) below:

$$\begin{aligned} r(t) = \alpha_0 e^{j\phi_0} pi(t-\tau_0) + \alpha_0 e^{j\phi_0} da(t-\tau_0) &\quad \leftarrow path\_0 \\ +\ldots &\quad \ldots \\ +\alpha_{L-1} e^{j\phi_{L-1}} pi(t-\tau_{L-1}) + \alpha_{L-1} e^{j\phi_{L-1}} da(t-\tau_{L-1}) &\quad \leftarrow path\_L-1 \end{aligned} \qquad (3)$$

Take two-path case for example, as in FIG 6, the received signal (3) with L=2 is represented in equation (4) below:

$$\begin{aligned} r(t) &= \alpha_0 e^{j\phi_0} pi(t-\tau_0) + \alpha_0 e^{j\phi_0} da(t-\tau_0) + && \leftarrow path\_0 \\ &\alpha_1 e^{j\phi_1} pi(t-\tau_1) + \alpha_1 e^{j\phi_1} da(t-\tau_1) && \leftarrow path\_1 \end{aligned} \qquad (4)$$

With reference to FIG 6, the received signal shown in (4) is before both blocks 611 and 612.

(2) <u>*Reconstructing and cancelling pilot signals in Huang et al.*</u>

Huang et al. teach to first reconstruct pilot signal at each finger (*e.g.*, col 8, line 2-6 or line 31-33). Take Finger 0 in FIG 6 for example, 606 reconstructs pilot signal 0, or $\alpha_0 e^{j\phi_0} pi(t-\tau_0)$ in (4). Then the reconstructed pilot signal is cancelled for each of the other paths (*e.g.*, col 8, line 9-11 or line 34-36). Again in FIG 6, 606 and 607 have reconstructed $\alpha_0 e^{j\phi_0} pi(t-\tau_0)$ and $\alpha_1 e^{j\phi_1} pi(t-\tau_1)$ respectively. For the upper branch, after the cancellation of the reconstructed pilot from path 1, *i.e.* $\alpha_1 e^{j\phi_1} pi(t-\tau_1)$, the signal is represented (suppose reconstruction is perfect without error) in equation (5) below:

$$\begin{aligned} & r(t) - \alpha_1 e^{j\phi_1} pi(t-\tau_1) \\ &= \alpha_0 e^{j\phi_0} pi(t-\tau_0) + \alpha_0 e^{j\phi_0} da(t-\tau_0) \\ &+ \alpha_1 e^{j\phi_1} da(t-\tau_1) \end{aligned} \qquad (5)$$

Similarly, the signal at the lower branch after the cancellation of $\alpha_0 e^{j\phi_0} pi(t-\tau_0)$ is represented in equation (6) below:

$$\begin{aligned} & r(t) - \alpha_0 e^{j\phi_0} pi(t-\tau_0) \\ & = \alpha_0 e^{j\phi_0} da(t-\tau_0) \\ & + \alpha_1 e^{j\phi_1} pi(t-\tau_1) + \alpha_1 e^{j\phi_1} da(t-\tau_1) \end{aligned} \tag{6}$$

And then demodulation is performed to use signals after cancellation (i.e. (5) and (6)).

(3) *The features of received signals of the present invention*

In the present application, the signal components refer to the signals on multiple subcarriers instead of multipath components. The received signal $\underline{\mathbf{r}}$ after passing through FFT module 412 is a vector in the format of (equation (2) at [0033] in the present application)

$$\begin{bmatrix} r_1 \\ \vdots \\ r_M \end{bmatrix} = \begin{bmatrix} \gamma_1 & & \\ & \ddots & \\ & & \gamma_M \end{bmatrix} \cdot W \cdot \begin{bmatrix} x_1 \\ \vdots \\ x_M \end{bmatrix} \tag{7}$$

After demodulation of $\underline{\mathbf{x}}$ in (7), the reconstruction and replacing process starts.

(4) *Reconstructing and replacing one or more weakest subcarriers of the present invention*

The present invention first reconstructs one or more weakest subcarriers (*e.g.*, r_1 *being constructed to* $\overline{r_1}$), and then replaces the

component r_1 in the received signal $\underline{\mathbf{r}}$ with $\overline{r_1}$. The resulting signal is represented in equation (8) below:

$$\begin{bmatrix} \overline{r_1} \\ \vdots \\ r_M \end{bmatrix} \qquad (8)$$

It is to be noted that the reconstructed component $\overline{r_1}$ is replacing the r_1 component but not being cancelled/subtracted from the received signal $\underline{\mathbf{r}}$. If the cancellation techniques from Huang et al. are applied, the resultant signal would be represented in equation (9) below under perfect reconstruction assumption:

$$\begin{bmatrix} r_1 - \hat{r}_1 \\ \vdots \\ r_M \end{bmatrix} = \begin{bmatrix} 0 \\ \vdots \\ r_M \end{bmatrix} \qquad (9)$$

It is evident that equation (8) is not the same as equation (9), demonstrating that the teaching of cancellation disclosed in Huang et al. is not applicable in the present invention.

The signal from the replacement is subject to demodulation again, and these steps may repeat a few times iteratively if desired. See, *e.g.*, [0041]-[0045].

(5) *<u>The reconstructed signal in Huang et al. is NOT applicable in the replacing process of the present invention</u>*

In the CDMA system as described by *Huang et al*, if we want to apply our replacing step, the signal after replacing path-0 pilot p(t) for with the reconstructed $\hat{p}(t)$, would be

$$\hat{r}(t) = \boxed{\alpha_0 e^{j\phi_0} \hat{p}i(t-\tau_0)} + \alpha_0 e^{j\phi_0} da(t-\tau_0) + \alpha_1 e^{j\phi_1} pi(t-\tau_1) + \alpha_1 e^{j\phi_1} da(t-\tau_1)$$

which is different from (6). In fact, it is not possible to do the "replacing" process in practice as the components in r(t) is not separated in the composite signal.

(6) *Kadous et al. fail to supplement the defects in Huang et al. in order to disclose all claimed features of the present invention*

Kadous et al. disclose a method to exploit fast fading to achieve a higher level of diversity and compensate for Doppler and frequency offsets as well as phase noise. In figures 1 and 7, col6, lines 1-6, col 8, lines 20-42, as cited by the examiners, Kadous et al select only a few ***adjacent*** subcarriers to do joint processing instead of using all subcarriers (abstract, col2 line 55, col3 lines 4, 22, 47, 49, 54, 59, col7 lines 31, col9 lines 12, 15, 18, col14, lines 2, 4, col15, lines 31, 49, col16, line 66, col17, lines 8, 45,59, Claims 1, 7, 10, 11, 16, 22-26, or col20, lines 7, 37, 49, 52, col21, lines 36, 64, col22, lines 4, 9, 17, 21,

Figures 10). This is because most of the signal information will be concentrated in a few adjacent subcarriers above and below the frequency of the subcarrier frequency in case of imperfection, instead of only one subcarrier in the case without imperfection (col3 lines 58-61, col7 lines 29-31, col9 lines 9-20). If one were to use the method as taught by *Kadous* et al to modify the method of Huang et al, one may identify either the adjacent paths or the stronger paths containing more signal energy for reconstruction and cancellation. Correspondingly, one may reconstruct the adjacent or the stronger subcarriers in our context. Therefore, the method in *Kadous* et al would by no means teach one to identify one or more signal components having one or more smallest channel coefficients.

(7) *Even if Huang et al. and Kadous et al. are impermissibly combined, they fail to teach or suggest the claimed subject matter*

As discussed above, the teachings from Huang et al. and Kadous et al. are completely different from the claimed subject matter of the present application in terms of concept, principle and implementation. Even if Kadous et al. and Huang et al. are impermissibly combined, they still fail to teach or suggest the claimed subject matters in the present application.

Therefore, the examiner fails to establish a *prima facie* case of obviousness for Claims 1-3, 6-7, 10-17, 20-23, 26-29, and 32-34 over Huang et al. and Storm et al.

Claims 4, 5, 8, 9, 18, 19, 24, 25, 30, and 31 stand rejected under 35 USC 103(a) as being unpatentable over Huang et al. in view of Kadous et al. and further in view of Dabak et al. (US 2003/0002568)

Claims 4, 5, 8, 9, 18, 19, 24, 25, 30, and 31 stand rejected under 35 USC 103(a) as being unpatentable over Huang et al. in view of Kadous et al. and further in view of Dabak et al. (US 2003/0002568). Applicants respectfully traverse the rejections for the reasons discussed above because Dabak fails to remedy any of defects in Huang et al. and Kadous et al.

Conclusion

Claims 1-34 are not unpatentable over Huang et al. in view of Kadous et al. or further in view of Dabak et al. for the above reasons even if they are impermissibly combined; therefore applicant respectfully request that the rejections be withdrawn.

Applicant respectfully requests that a timely Notice of Allowance be issued in this case.

Respectfully submitted,

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